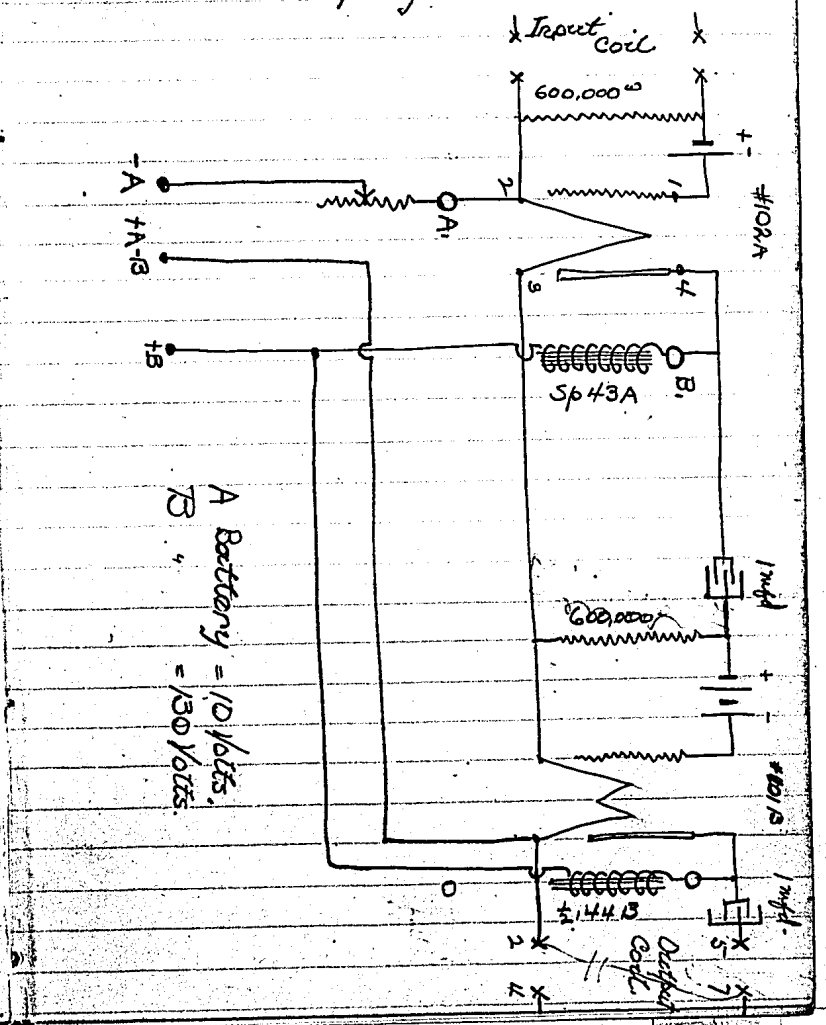
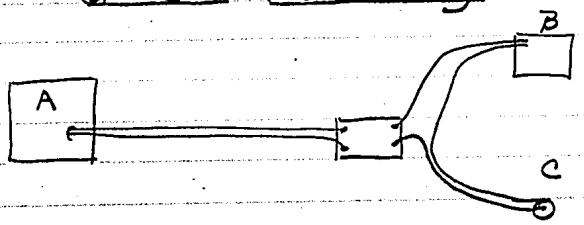
Notebook Series -- Notebooks by Experimenters Other Than Edison
Navy and Wartime Research Experiments -- A. M. Kennedy Books
Notebook, N-17-03-06

This notebook was used by Absalom M. Kennedy in March 1917 for notes on experimental work for the U.S. Navy performed under the direction of Edison during World War I. The book, which has been used in both directions, consists primarily of notes on experiments involving amplifiers, audion circuits, transmitters, and transmitter parts. At the other end are a few pages containing descriptions and drawings of transmitters, numbered E1-E6 and E31. Several entries include notations by Edison or remarks by Kennedy about his opinions and suggestions. The notes indicate that E. Rowland Dawson and Joe Meilner also worked on these experiments. Two items, including a note in Edison's hand, have been inserted into the book. The front cover is labeled "Experiments. #2 March 6 - March 20." The pages are unnumbered. Approximately 110 pages have been used.

W.E. Co. Corrections for special amplifier.



Tests of Amplifier with break running.



A closed. no phone on.
B " Has receiver on
C running

(1)

Straight circuit as above.
Chirrups

(2)

Connected Leeboundy ground.
Stops Chirrups. Hear Brake wheel 52

(3)

1 mfd condenser across 2-7 of output coil.
Stops Chirrups. Break wheel louder.
Sudden break at 2

50

(4)

Condenser across 2-4
Chirrups

(5)

Condenser across 4-5
Continuous loud noise.

(6)

Condenser across 4-7
Continuous loud noise.

(7)

Condenser across 5-7
Chirrups - slow

(8)

Condenser across 2-5
Chirruping stopped. Noise very slight. 30

(9)

3500$^{\omega}$ across 2-7
Chirruping stopped. Loud noise 60

(10)

3500$^{\omega}$ across 2-4
Chirrups.

(11)

3500$^{\omega}$ across 2-5
Loud noise

(12)

3500$^{\omega}$ across 4-5
Chirrups.

(13)

Chirruping stopped. Loud noise.

(14)

3500ω across 5-7. - Chirrups.

Since (8) was good compare with it.

(1)

1 mfd condenser across 2-5
No chirrup. Slight noise 30

(2)

2 mfd across 2-5
Very slight noise but intermittent slowly, louder 20

(3)

6 mfd across 2-5
Cuts out almost all noise but slight intermittent 8

~~Then connected transformer #9 across circuit between audions.~~
~~Chirruping stopped~~

Then put #7 coil in place of #9- high to audion, low to receiver.

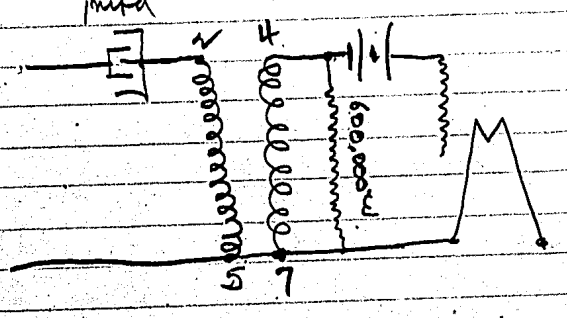
① Regular circuit
Chirrups

② Using Leibowitz ground
Stops chirrups. 56

× ③
1 mfd condenser across 2-7.
Stops chirrups. Some noise. 60

④
1 mfd condenser across 2-5
Stops chirruping, no noise 22

⑤
Then put repeating Coil #9 between audions



(5)

With #9 repeating coil as choke stops chirruping but the break noise is very prominent

(6)

Then put on Leibowitz ground Large part of the break noise is cut off measures 50

(7)

Removed ground and put 1 mfd condenser around 2-7 of output coil Break noise less 30

(8)

Then reversed connections 4 and 7. No ground or condenser. Noisy -- very like (5)

(9)

Then put on Leibowitz ground - Still noisy.

(10)

1 mfd condenser 4-7. Noise much reduced 30

(11)

Removed condenser. Noise. Then connected neutral point of the primary & secondary of output pot

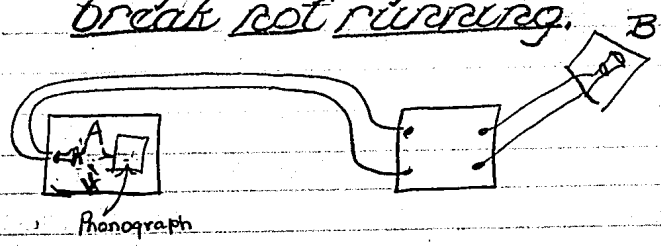
coil together. Same noise

(12)

Then connected up as in 7 (mfd condenser across 2-7), and started the vibrating spring with magnets connected in A circuit

Can hear the oscillations but they are very faint, not as good as without the audion.

Tests for amplification, break not running.



A = receiver on, 4' from phono in box.
B = receiver held in mouth.

(1)

Straight circuit as (5) — with repeating coil between audions out but Telephone, ground in Heater

(2)

1 mfd condenser connected from 2 ÷ 7 of output coil
Hear at 60

(3)

Repeating coil between audions as in (5).
Now get high pitched whistle.

(4)

Combining (2) + (3)
Heal at 60.

(5)

Repeating (2) with 2 mfd condenser 60

These run to 60, the end of the scale.

~~Set Phonograph 6' from transmitter~~

(6)

With 1 mfd condenser 2-7
Hear at 50

(7)

1/10 mfd condenser at 46
(more noise)

(8)

~~With 2 mfd condenser~~
hear at
~~(Sharper noise not so loud~~ 52

These run to 60 - end of scale
so moved phonograph 6' from
transmitter to reduce figure.

(6)

With 1 mfd 2-7, output coil 60

Moved receiver to 8' from
phonograph
Still hear at 60

Put Miners Lamp Case &
battery in front of transmitter
at 8" (Phone going) 54

(7)

Used 1/10 mfd. condenser 54

(8)

Used 2 mfd condenser 54

(9)

Used 6 mfd condenser 58

Mr. Edison said that the trouble was really leakage in the output coil.

Had 2 Bunnell coils used in place of W. E.

These cut out the chirruping and a great deal of the dynamo noise. Showed 36 where W. E. showed 50.

Tried these on break wheel. Very loud noise.

Then grounded both sides of primary threw about 500 Ω resistance. Just as loud.

Both sides of secondary through same resistance. no difference.

Both sides of primary through 2 mfd. condenser. no sound.

Mr. E. then states that trouble was in the insulation between primary and secondary coils and that the a.c. was leaking from the one to the other and that new coils

would have to be tried.

Experiments on Amplifier

(1) Connected 2 mfd. condenser around break.
Killed noise of break entirely.

(2) Started up radiator on system.
Could not hear radiator.

(3) Cut input coil out and connected direct to amplifier.
no better results.

(4) Used telephone receiver as transmitter.
Most perfect telephone conversation I ever heard through the break.

(5) Then cut off the break.
no change in conversation.

(6) Then took out pert coil out so as to talk directly thru amplifier.
Conversation a little weaker.

(7) Then connected radiator in this circuit.

Could not detect oscillations

(8) Then connected break in primary circuit.
Could not hear.

(9) Then put 1/10 mfd. condenser in shunt with break.
Can hear break and little of oscillations

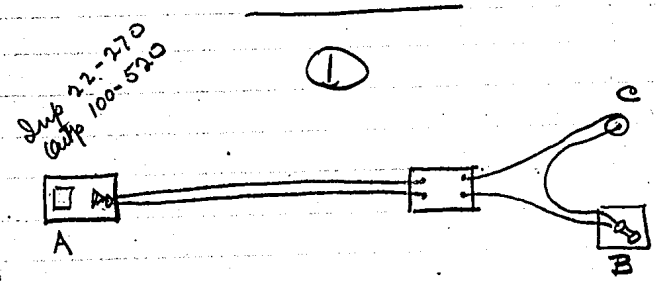
(10) Then connected the break so that it was back in the receiver circuit. No better.

(11) Then connected in Bunnell coils as input & output. All singing & chirruping stopped.

After a number of trials with and without break, found that the trouble we have been experiencing was because of a super sensitive input coil - not trouble with output and that when this coil was removed, dynamo noises singing & chirruping etc were also removed, though the amplification may not be as loud.

3/7/17.

Reconnected W192 (Range Inputs) coil so as to give 2165 - 4387 connection. On connecting up, this gave a very high pitched note with telephone in circuit at A.



A - closed, phone on line
B - closed
C - running.

Input coil P22-5270 Bunnell
primary to A - secondary to audion
Output Coil P100-5520 Bunnell
primary to B - secondary to audion

Break noise loud
Still hear at 60

(2)

Stopped C on contact. Phono running at in box. Transmitter 8' from box behind miners lamp cask or battery.

Hear at 42

Line singularly noiseless

(3)

Put 1/10 mfd condenser around break

Break noise very slight.

Cut out at 24

(4)

Put 1 mfd condenser around break.

Very little noise from break

Cut out at 20

(5)

Mr. Edison took cloth insulation around primary of output coil. I removed cloth around input coil. With no condenser around break.

Nearly all noise removed - Cut out at 24.

(6)
Input coil then covered with original cloth.
Horse louder. Cuts out at 56

(7)
Then cut out the telephone and short circuited A.
Noise practically cut out.
Input coil has cloth —
output coil cloth off acr insulation

(8)
Put receiver on A. Phonograph in box, receiver 8 ~~ft~~ distant and behind miners lamp battery.
Stopped break on contact.
Box reading 42

(9)
Then took cloth off input coil, testing as in (8)
Box reading 42.

(10)
Replaced input coil (Bunnell) with W. E. N. 192. Short circuited line at A.
Got chirruping.

Then put on (11) Leibowitz ground - Chirruping stopped.

Resistance of Coils used.

Input W.E. W192 { Primary 1.30 ohms. (1.30 ✓)
Secondary 1760. " (1758)

Burnett Coils.

Primaries:

① + 11 ohms
② 22 " V mpd 101
③ + 100
④ 260 "

Secondaries:

① 130 ohms
② 270 "
③ + 520 "
④ 1000 " N°1
⑤ + 2800 "

130
270
520
1000
2800

(12)
Connected Bunnell Coil
11-2800 in circuit as
of input coil. Break
Running, A closed.
Chirrups badly.

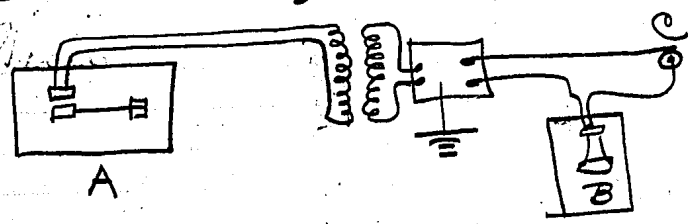
(13)
Then put on Reluctivity ground.
Chirrup disappears.
Slight Brake noise cut out at 16

(14)
(Stopped) Break on contact
connects transmitter at A
& started phonograph
Hear to

48.

9/7/17 - night

Detectors of Vibrator.



Tests made by connecting magnet of vibrator to line at A. This goes to 11-2800 Bunnell coil and to audion board. Through 520-100 Bunnell coil to break C (running in series with receiver B.

Had Dawson start vibrator & count for 15 seconds, I must repeat count to insure correctness Ludowitz ground on-

(1)

Small Vibrator - Fast. Can not hear at all

(2)

Cut out Bunnell coil 11-2800 connecting A direct to Audion. Hear slightly but could not count.

(3)

To make sure circuit was complete, put transmitter on A and had Dawson talk. Could hear him, jumbled of course through break.

(4)

Took off Leibowitz ground, leaving Radiator direct to Audion board.
Circuit noiseless.
Can not hear anything.

(5)

Put Bunnell coil 11-2800 back in circuit, - no ground - Can hear break.
I got 65 Dawson 58 first trial
" " 59 " 57 second "
" " 56 " 60 third "
This is the first time I have been able to detect.

(6)

Then connected 1/10 mfd condenser around break. Noise of break wheel much reduced

1st trial Dawson 53 Kennedy 54
2nd " " 54 " 53
3rd " " 55 " 57

In these, I really hear only the 1st. 12 or 15 beats and continue the count on the rest to 15 sec.

(7)

Then had Dawson make the vibrator slower, so that I could not remember the speed of beats.

1st trial Dawson 36 - Kennedy 41.
2nd " " 37 - " 38-
3 " " " 38 " 37-

I do not believe however that a person without a keen sense of musical rhythm would be able to do this.

Dawson ~~then~~ moved ~~the~~ magnet back ~~so that~~ it was close ~~to the~~ spring ~~rather than the~~ weight of the vibrator.

(1)	Dawson	38 - Kennedy	40
(2)	"	37 "	36
* (3)	"	32 "	31
(4)	"	34 "	35

* speed changed here.

In all of the above the spring hit or touched the magnet faces so as to give a distinct sound.

Then tried to vibrate so ~~that~~ the ~~spring~~ would not hit the magnet. I was not able to count such because I could not get the rhythm of the first beats.

⑨

Then connected through direct from A to B & C without amplifier. 1/10 mfd condenser shut on break

① Dawson 31 - Kennedy 31.
② " 31 - " 33.
③ " 31 - " 31.

Dawson moved weight.
① Dawson 42 - Kennedy 43.

Dawson moved weight
① Dawson 28 - Kennedy 28.

Dawson moved weight
① Dawson 35 - Kennedy 36.

In no case above did the spring touch the magnets. I can hear each beat perfectly ~~so that~~ This is much more sensative than with the audion.

(10)

Then removed condenser from break wheel.

① Kennedy 44 - Dawson 39 -
② " 41 - " 41 -
③ " 37 - " 37 -

While I got the above, I made some false takes and could not hear as well as before.

(11)

Then put mfd. condenser around break.

① Dawson 34 - Kennedy 36
② " 46 - " 46
③ " 39 " 39

Reduced amplitude

① Dawson 32 - Kennedy 32
② " 46 - " 46
③ " 40 - " 43

Results not as reliable as at 1/10 mfd.

(12)

1/10 mfd condenser at Artex as standard.
Changed to large radiator.

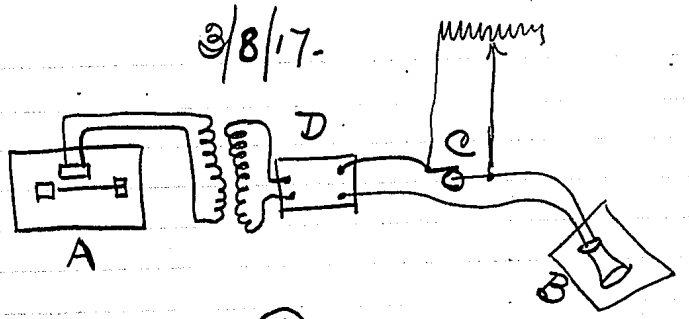
(1)	Dawson 45 -	Kennedy	46
(2)	" 45 -	"	45
(3)	" 47 -	"	47
(4)	" 52 -	"	52

(13)

Then connected in circuit with Bunnell coil 11-2800 and audion. No ground

Variations	Dawson 43 -	Kennedy	43 Dial
	" 49 -	"	48
	" 48	"	48
	" 54	"	51
	" 52	"	52

3/8/17.



(1)

Used Range valuator at A, audion with 11-2800 Bunnell coil at D-
C stopped on contact
B closed.
Experiment to see if we could hear A with C not running.

Can not hear when valuator works normally. Can hear when the spring touches the magnet.

(2)

Then started C, shunting with various resistances to keep down noise—
(1) Infinite Resistance. Can hear only when spring touches magnets.

② 1000 ohms around C.
Still hear break. Can not hear the vibrator

③ 500 ohms around C.
Still hear break. More musical sound. Can not hear vibrator.

④ 200 ohms around C.
Still hear break. Loud as ever.
Can not hear vibrator.

⑤ 100 ohms around C.
Still hear break as loud as ever.
Can not hear vibrator,

⑥ 50 ohms around break.
Get dynamo-noise much more prominent. Break noise still.
Can not hear vibrator.

⑦ 20 ohms around C.
Get dynamo noise & break
Can not hear Vibrator

⑧ 10 ohms around C.
Dynamo and break noise
Can not hear vibrator

⑨ 4 ohms around C
Dynamo and break noise
Can not hear vibrator

⑩ Stopped break wheel.
Hear Dynamo noise.

(10) 2 ohms around C.
Dynamo noise. Break noise very slight.
Can not hear vibrator.

(11) 1 ohm around C.
Dynamo noise. Break noise slight.
Can not hear vibrator.

(12) Short circuit C.
Dynamo noise. Very slight break noise.
Can not hear vibrator.

Test of Pasteboard Box for transmitter.

Mr. Edison had box 8' long 12" x 12" section made to keep external sounds out of transmitter which is enclosed in another box 6" x 6" x 8" with hole in front opposite diaphragm.

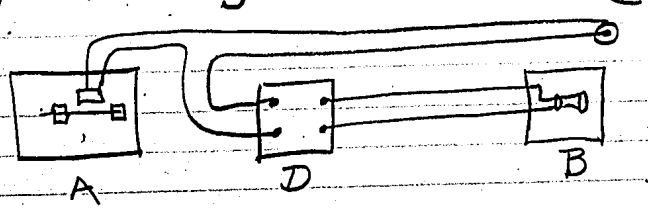
With diaphragm on this open head to

Test of Diaphragm of transmitter Box.

Wide open	(piano going)	44
3/4	" "	44
1/2	"	44
1/4	"	42
Closed		42

This means that the small box must be made more nearly sound tight.

Test of Viabrator in primary circuit.



A = Vibrator connected
B = Closed
C = Running
D = With 11-2800 Bunnell coil as input and 520-100 Bunnell

coil as output.

(1)

Oscilvation moving very slightly.
Magnets 3/16" from Reed
Dawson 31 – Kennedy 31 Oscilvations
" 36 – " 35 "
" 40 " 40 "

(2)

1/10 mfd condenser around break.
Dawson 38 – Kennedy 37 – Oscilvations
" 30 – " 32 "
" 31 " 37 "
(Magnets 3/16" from Reed)

(3)

Magnets 1/4" from reed.
Dawson 29 – Kennedy 30 oscilvation

(4)

Magnets 5/8 from reed.
Dawson 30 – Kennedy 32 oscilvations

(5)

Magnets 1/2" from reed.
Dawson 30 – Kennedy 29 Oscilvation

(6)

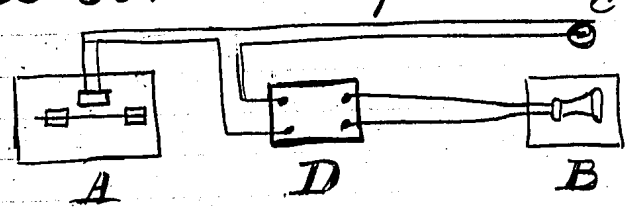
Magnets 1/2" from reed
Dawson 34 – Kennedy 33 oscilvation

60 / 9420 / 157 60 / 11100 / 185

(7)

Mr. Edison then directs to try and hear fan blades going slowly. Could not hear this.

Test of Break Wheel at various speeds.



A closed, vibrating 1/2" from magnets
B " " with receiver.
C running at following speeds in breaks per second.

(1)

C = 157 breaks per second
Dawson 29 & Kennedy 31 Vibrations
Can just hear.

(2)

C = 185 breaks per second.
Dawson 31 - Kennedy 30 vibrations
Can just hear. No improvement

60/1247R 6/452
707 742

(3)
C = 707 breaks per second
Dawson 37 - Kennedy 32 evaluations
No improvement

(4)
C = 247 breaks per second
Dawson 31 - Kennedy 33 - evaluations
No improvement.
Break jumps and is irregular at this speed.

(5)
Then adjusted spring of break so as not to jump so much
C = 247 breaks per second.
Dawson 32 - Kennedy 32 evaluations

(6)
Then adjusted spring a little tighter. Sound cleaner
C = 242 breaks per second
Dawson 31 - Kennedy 31 evaluations

Experiments at lower speed.

(7)
C = 150 evaluations per second.
Dawson 35 - Kennedy 35 evaluations

6/780
130

92
2/18
60
1800

6/200/33

(8)

C = 130 evaluations per second.
Dawson 34 - Kennedy 36 evaluations.
Think I hear better at this speed.

(9)

C = 90 evaluations per second.
Dawson 34 - Kennedy 35 evaluations
Then tried evaluating at lower amplitude -
Dawson 34 - Kennedy 35 evaluations
Seems better at this speed.

(10)

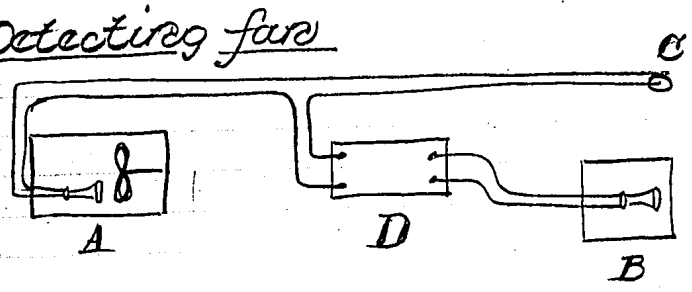
C = 55 evaluations per second
Dawson 33 - Kennedy 35 - evaluations not so good. Could not get lower amplitude.

(11)

C = 33 evaluations per second
Dawson 35 - Kennedy 35 - evaluations
Tried lower amplitude.
Dawson 34 - Kennedy 35 -
but not very plain.

3/9/17.

Detecting fans



A = closed with transmitter.
B = " " receiver.
C = running, normal speed 150 breaks per sec.
D = with Bunnell 11-2800, 520-100 coils.

(1)

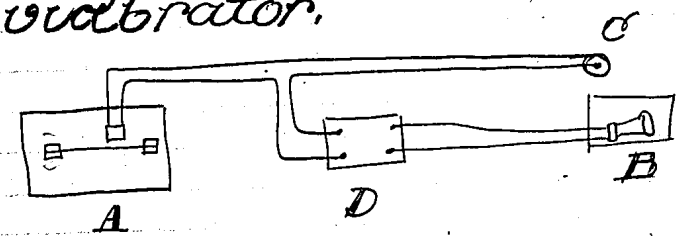
Lowest speed at which I could detect fan running was 784 r.p.m.
As there are 4 blades to fan, this means 3136 impulses per minute or 52 per second.

I do not believe this speed is necessary because of the number of impulses per second but because it requires this speed to produce breeze enough to hear.

392
2
784
4
3
60|3136
52

Test of Calibrating Box.
and of new coil.

Test of distance of magnets from large vibrator.



A = closed with vibrator magnet
B = " " removed.
C = running about 90 breaks per sec.
D = Chas Bunnell 11-2800, 20-100 coils.
Swing of spring of A = 1⅛".

(1)
Magnet 3/16" from spring
Dawson HO, Kennedy 4 vibrator
Loud & clear

(2)
Magnet 5/16 from spring
Dawson HO - Kennedy 3 vibrator
Loud & Clear

(3)
Magnet 1/2" from spring,
Dawson HO - Kennedy 3 vibrator
Loud and clear -

④
Magnet 5/8" from spring
Dawson 4V - Kennedy 4V - evaluation
Not very loud but clear.

⑤
Magnet 3/4" from spring
Dawson 41 - Kennedy 4V evaluations
Still clear.

⑥
Magnet 7/8" from spring.
Dawson 4V - Kennedy 43 evaluation
Hard to get & distinguish.

⑦
Magnet 1" from spring
Can not distinguish

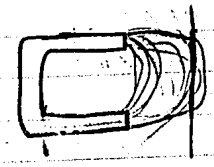
⑧
Then moved magnet opposite
weight to see if this would be
more efficient.
Magnet 1" from weight.
Dawson 4V - Kennedy 4V - Evaluations
Loud and clear here.

⑨
Magnet 1/8" from weight.
Dawson 40 - Kennedy 40 evaluations
Loud & clear.

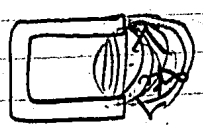
Deduction

The limit of hearing comes suddenly.

Space between poles of magnet = 3/8".



At ordinary distances some of the lines can reach the vibrating weight



At greater distance Romans they have no tendency to jump the double air space

(10) Magnet 1 1/4" from weight. Dawson 42 - Kennedy 43 Oscillations still clear.

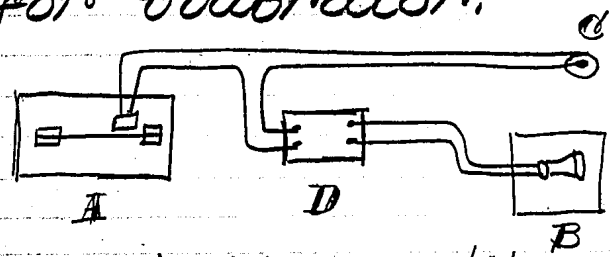
(11) Magnet 1 3/8" from weight. Dawson 41 - Kennedy 40 oscillations Very faint. Do not believe I can hear farther.

(12) Magnet 1 1/2" from weight. Can not distinguish.

69/16 C 27

117
1188

Experiment to find most efficient speed for vibrator.



A = closed with magnet 7/8" from spring of vibrator.
B = closed with reamer.
C = running at about 90 breaks per second.
D = used with Bunnell 11-2800, 520-ohm coils.
Large Vibrator used.

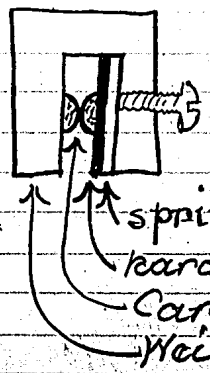
(1)
With weight at end of reed.
Dawson 47 - Kennedy 40 - Vibrations
(2 2/3) (2 2/3)
Very faint. Can just hear.

(2)
Weight moved 4 3/8" from end
Dawson 47 (3) - Kennedy 47 (3) - vibration
Seems little louder.

~~6/40 v 3.7~~ 6/40 v 3.7

6/20 v 3.7 6/21 v 3.5

Suggest for sensativeness
Carbon contact between the weight and reed so as to vary contact & current as the weight swings.



(3)
Weight 7¼" from end.
Dawson 48 (3.1) Kennedy 47
Seem to hear a little better.

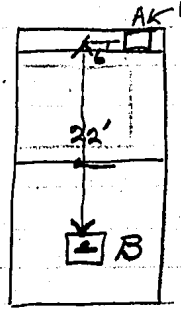
(4)
Weight 10¼" from end.
Dawson 53 (3.5) Kennedy 53
Seem to hear better.

(5)
Weight 13½" from end.
Dawson (3.7) 55 Kennedy 55.
Hear fairly

(6)
Can not get with weight off as the spring will not vibrate for 10 seconds

3/9/17

Test of EI Transmitters



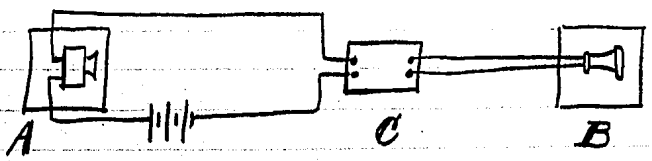
Distance & conditions

A = Phonograph in box with 3/4" hole. W. E. Counting Record #1 used.

B = Microphone, mounted on 2 lead blocks with cow hair between.

Door between rooms closed.

Wiring Diagrams.



A = transmitter, with 3 cells battery

B = receiver boxes.

C = Audion using Bunnell coils 11-2800 | 260-100 coils, as input & output.

(1)
Set up and tested out. Could hear with door open. Could not hear with door closed.

(2)
Tapped & shook transmitter. Able to hear with door closed at times as far as 300 meters

(3)
Shook transmitter again and changed primary of input coil from 11 to 280.
Could not hear at all after considerable search found that transmitter was tilted in at 90° from correct position so that balls did not touch. On turning could just hear with door closed but transmission rough & coarse.

(4) Replaced 11 primary
Tried tuning transmitter by "squealing" with receiver.
Somewhat more sensative can hear at 17 but coarse.

Deductions –

① It is evident that tuning the transmitter improves it wonderfully.

② That a high ratio of turns is needed in the input coil rather than a greater number of turns on primary but with less ratio.

⑤

Disassembled transmitter. Found diaphragm in good shape, every ball in place. Set up. Could not hear with door closed.

⑥

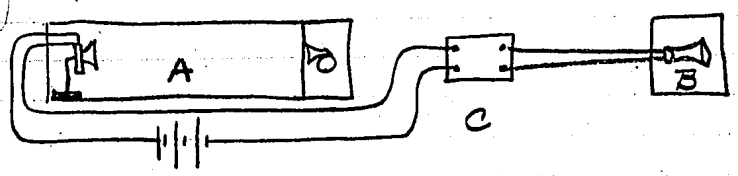
Tuned again by squealing with receiver. 11 primary used. Worked fine. Heard to 60 with doors closed

⑦

Changed input coil to 380 primary. Could not hear as well as with 11 coil. Only ± 38.

9/10/17.

Test of E-3 Transmitter



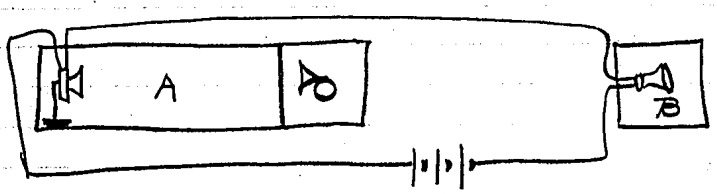
A - E-3 microphone in long box, 7'-3" from phonograph, in box with 3/4" hole. 3 cells battery used.
B = closed with pecmen's boxes.
C = audion Bunnell 11-2800; 260-100 coils

(1)
E-3 at 0°.
Could hear to 60

(2)
E-3 at 15°
Could hear to 60.

Mr. Edison consented to make preliminary test without amplifier.

Test of E-3 Transmitter.



A = E-3 microphone in long box 7'-3" from phonograph in box with 3/4" hole. 3 cells battery used

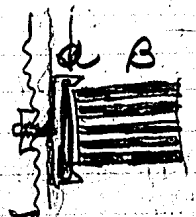
B = Closed. Receivers & two-ears

(1) Transmitter aimed natural.

	coming down	going up
E-3 at 0°	40	32
" at 5°	46	26
" at 10°	48	46
" at 15°	46	40
" at 20°	50	40
" at 25°	52	54
" at 30°	54	54
" at 35°	50	50
" at 40°	50	48
" at 45°	52	50
" at 60°	52	50
" at 90°	52	52

Measuring Inductance
" Capacity

E-4 receiver is bad in design in that



Diaphragm

(1) Bearing to be neutralized by attaching carbon to diaphragm by means of rod.
(2) The carbon is liable to buckle because of the support
(3) Liable to touch back carbon because of linear clamping ring.

Test of E-4 Transmitter

Under same conditions as E-3

	down	up
E-4 at 0°	38	42
" " 5°	32	40
" 10°	42	40
" 15°	36	36
" 20°	34	32
" 25°	32	34
" 30°	34	26
" 35°	24	38
" 40°	24	38
" 45°	28	34
" 60°	28	26
" 90°	30	30

Transmitter quality fair, loud, metallic unnatural.

3/10/17

Test of E-3 against E-1.

Set up E-1 as last night
With door closed can hear to 38

E-3 with door open hear to 18

3/11/17

Test of E-4 against E-1

Set up E-1 as last night. With door closed can hear to 52

E-4, inclined 15° door open hear to 40
" " 15° " closed " " 18
Quality sharp. Not as good as E-1

Test of E-1 with only 12 rows of tubes loaded with balls.

Door open hear to 36
Door closed hear to 14

Mr. Edison states this should be more sensative than above & trouble is with the balls.

Found that the balls packed in the holes due to
1. Out of round
2. Broken balls & chips.

Mr. E. had Meilner make gauge to pick only balls of proper diameter.

Previous rolling on glass shows have eliminated the out of rounds.

Mr. Edison had Meilner make up gauge for balls.

Test of E-4 with tested balls

Test of E-5 against E-1

E-1 can hear to, door closed 58
E-5 " " "

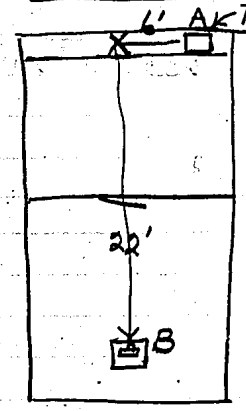
→ at times can hear clearly to 60 then fades off to nothing very irregular. Sh[illegible] by turning but does not hold.

Could only hear by closing the opposite opening. With both open could not hear anything.

On opening up, found only one row of balls in place and this one packed.

This is an awful transmitter to assemble. The diaphragm is not fixed but loose between the two back electrodes. The adjustment will be 99% guess, if possible at all.

Tests of Transmitters filled with selected balls.

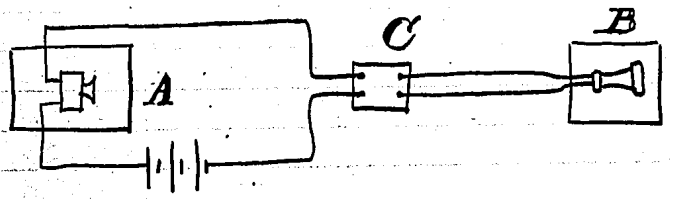


Distance and conditions

A = phonograph in box with 3/4" hole. WE counting record #1 used.

B = microphone mounted on 2 lead blocks, with cowhair between.

Wiring Diagram.



A = transmitter with 3 cells battery

B = receiver and boxes

C = Audion using Bunnell coils 11-2800 input 260-100 output.

① Transmitter, E-1.
Door open Rear to 60
Door closed " " 54

② Transmitter E-3 inclined 15°.
(Could not get it to squeal with receiver)
Quality not as good when Dawson talks and
Readjusted so as to squeal with
receiver.
Could not hear with door open
loaded, -12 rows.

③ Transmitter E-4 inclined 15°
Door open to 28
Door closed to 6
Very noisy. Grup & Dingo.

④ Special Magnetic
Transmitter E-6
at 5' from phonograph.
Can hear to 8.
Standard Bell Receiver 46

⑤ Transmitter E-4 as is ③
but with rubber on each
side of diaphragm.
Noisy
Door open hear at 30
Door closed " " 6

⑥ Same as ⑤ except that only 9 balls in rack of 12 holes.
Door open hear to 22

3/13/17

Test of E-4 receiver with .002" mica in place of copper diaphragm. 15°.

1 Remodulated E-1
With door open could hear only to 22
Readjusted by singing –
With door open, can hear to 60
With door closed " " " 44
Then turned up E-4 so that it sings.
So noisy that I can not hear
Turn inclined to 30°.
With door open hear to 60
With door closed, so noisy I can not hear phonograph but can hear Dehero typewriter easily

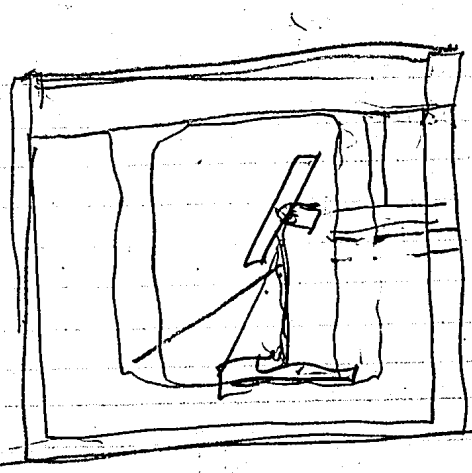
Then changed E-4 to 45°
Above noise can just pick up phonograph at 12

Comparison of Noise –

Laboratory	100%
Eagle Rock Casino, Back Room	60%
" " " Front "	40%
" " " Outer Hall	20%
Cellar, Hutchisons House	10%
Columbia St. Studio	25%
Cellar, Mt. Pleasant Ave	3%
Cellar, Mr. Edisons (Boiler)	8%

Test of E-4 with rubber stopper in opening.

Putting rubber stopper in opening of E-4 diminishes noise slightly but does not remove. Reduces not more than 20%.



Distance I can hear watch.

In Laboratory (day) about 30"
Columbia Ft. Studio, Reception Rm 63"
" " " Recording Rm 72"
" " " Booth 90"

Test of E-4 Transmitter in padded box

Transmitter tuned at 15°
Put in box padded with cow hair. Rubber stopper in opening.

Can still hear steady roar. This is continuous and with but little variation. Is non periodic and does not contain high pitched notes noticed this morning.

Can not hear phonograph

Then took rubber stopper out.

Noise practically the same as with stopper in.

With door open can hear to 38
With door closed 30

Dawson then padded around transmitter to prevent any vibration on stand. Also added weights on base. Cowhair used around transmitter to stop any vibration.
No stopper in opening
Still get roaring. Steady.

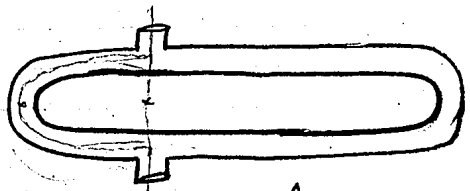
Door Open, Hear to 60
Door Closed " " 94

Then had stopper put in opening this caused considerable popping frying and some musical notes which did away. Noise same or worse
Can not hear phonograph.

With microphone in box and opening closed with stopper, on talking several inches from the box opening, the voice is reproduced very loud in booth.

This proves that the microphone is very, very sensitive, so much so that it must be well insulated and closed off from vibration and sound if the tube is to reproduce at all.

Test of Interference Tube.



Length ~~short path~~
Outside 3', Inside 2'-6", mean 2'-9"
~~Long path~~
Outside 5'-6", Inside 5'-0" mean 5'-3"

Preliminary test. A-435 seems loud
C-517 " weak

Test of Transmitter E-1. for noise - 3 cells.

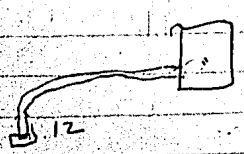
With opening free, noise to 50
" " closed " " 42

Thus shows that the noise either comes from jarring Microfone or its frying of the Audion

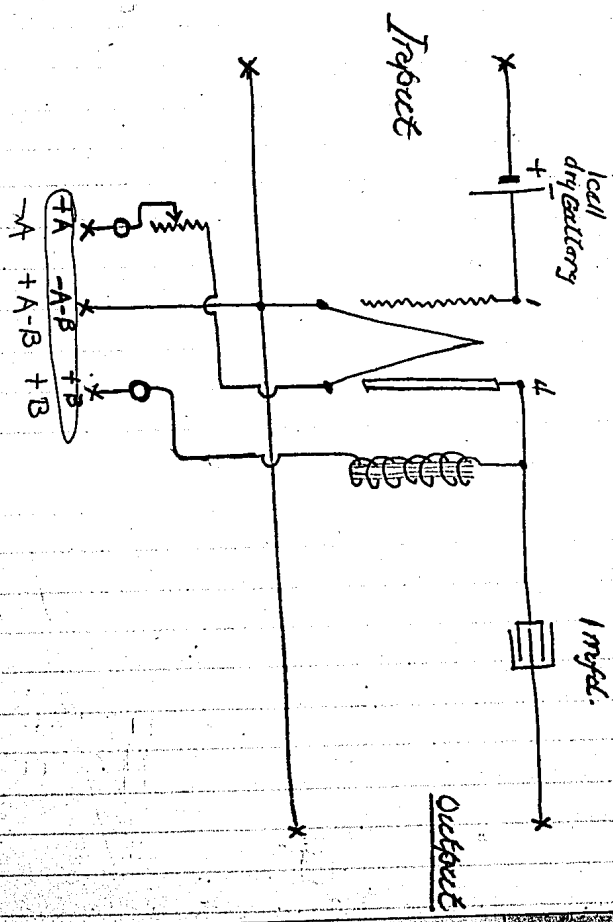
Test of Transmitter E-1 for noise from battery.

Rubber cork in opening

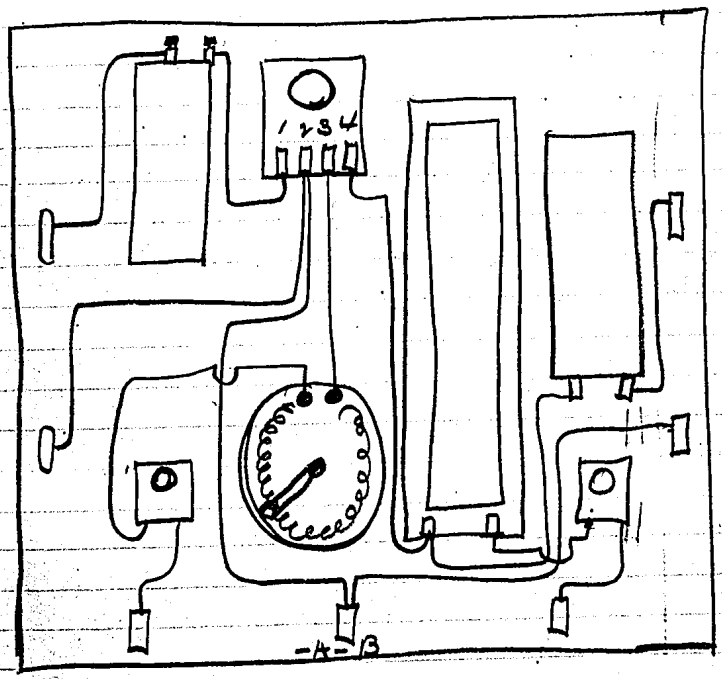
3 cells battery on Transmitter 52
2 " " " " 44
1 " " " " 34
Battery disconnected, terminals shorted 28
~~Battery~~ Line to Mirror room disconnected " " shorted 16
Line loose from Audion. No input circuit 12



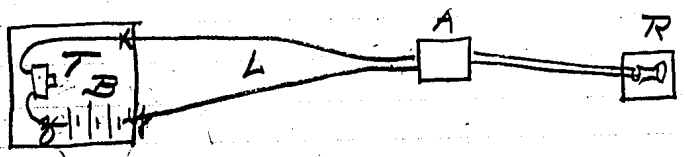
Wiring Diagram of W.E. 1 stage amplifier.



Assembly of V.F. 1 stage amplifier.

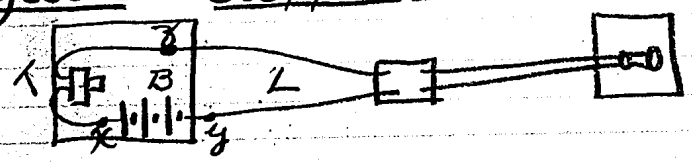


Test of Transmitter E-1, tube and amplifier for noise.



① As shown, 3 cells battery on T — 52
② As shown, 2 cells battery on T — 44
③ As shown, 1 cell battery on T — 34
④ Battery disconnected, y & z shorted — 28
⑤ Battery disconnected, x & y short circuited — 16
⑥ Line L loose from A. Only amplifier & receiver in circuit — 12
⑦ Repeating ④ to contrast with next experiment — 32
⑧ As 7 but x & z open — 28
⑨ Repeating ⑤ — 16
⑩ Same as ⑨ but with x-y open — 32

Test of Transmitter E-1, tire and amplifier for noise after B battery has been insulated on glass. Stopper in I



①	As above, 3 cells on I	52
②	" " 2 " " I	44
③	" " 1 " " I	40
④	Battery out, x, y connected together (noise changes to dynamo note)	24
⑤	Same as 4 except x, y open (dynamo note still the most prominent)	28
⑥	I cut out also, battery z connected together (dynamo noise slight)	14
⑦	Same as 6 except y, z open	30
⑧	Then disconnected talking telephone both ends & took ⑦ over	30

We now pull out primary of input coil 16
Entirely Dynamo

(9) Bell receiver, substituted for T, and 3 cells of battery on line L.

Noise 80% dynamo
20% roar
Cuts out at 28

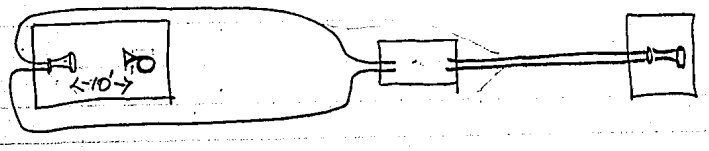
(10) Then put Twitch rubber stopper in opening in place of Bell receiver, and 3 cells of battery on line L

Noise = 20% dynamo
80% roar
Cuts out at 56

Dynamo is of course weakened by big decrease of Microfone-

Therefore there is a roar from Micro- Street Car going past roar increases 50% showing Micro is jarred & thus produces roar-

Preliminary comparison of regular telephone and of amplification by 1 and 2 audion tubes.



① With two stage audion. Bell receiver as transmitter, 10' from open phonograph, MC Counting record #1 used. Can hear to 60

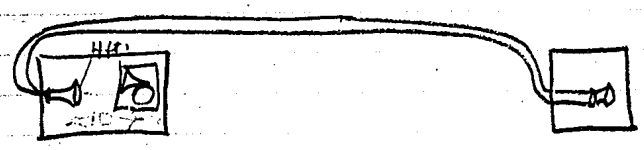
② With 1 stage audion, without input or output coils 14

14

③ Audion cut out, telephone straight through to booth 30

These results do not seem right - that the two stage audion only amplifies to twice as much as straight circuit and one stage 1/2

Comparison of Audions with straight circuit.

(1) 

(1) Reel record 4' from phonograph in box playing V.E. Co counting record #1.
Clear to 12. 12
No noise

(2) 1 stage audion in circuit with Bunnell 11-2800 input and 520-100 output coils. 8
(no noise)

(3) 2 stage audion in circuit with Bunnell 11-2800 input and 520-100 output coils
slight noise, mostly dynamo hum
Read to 48.

Measurement of resistance change of E-1 transmitter when current is flowing.

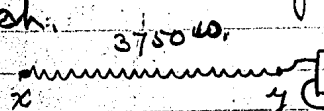
1 = 3200 ohms with bridge
1 cell battery, .5 milliamp 1.4 volt

2 = 4000 ohms with bridge
1 cell battery .3 milliamp. 1.4 volt

3 = 2200 ohms with bridge
1 cell battery .6 milliamp 1.4 volt.

This is too rough a test to show what Mr. Edison wants, whether the resistance of the microphone changes when current flows through it.

Then tried connecting 3750 ohms in series with microphone and measuring voltage around each.



Showed 1.4 volts x-z. .08 volts x-y. 1.12 y-z.

1.37 + .01337 = .0185

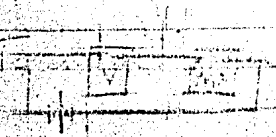
This shows that the resistance of the voltmeter is too low to measure such emfs.

Measured and found that the resistance of the 3 volt scale = 350 ohms.
Of the 150 ohm " = 17,500 " .

This means if used as a mill-ammeter:
On 3 volt scale, 1 volt = .00285 amp.
On 50 " " 1 " = .000571 " .

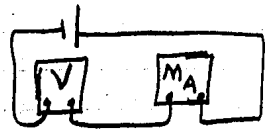
On my multi-scale ammeter & voltmeter -
1.5 volt scale = 74.8 ohms
15 " " = 748. ohms
150 " " = 7480. "

1 Volt reading on 1.5 volt scale = .01337 amp
1 " " " 15 " " = .001337
1 " " " 150 " " = .0001837



To make [illegible] voltmeter [illegible]

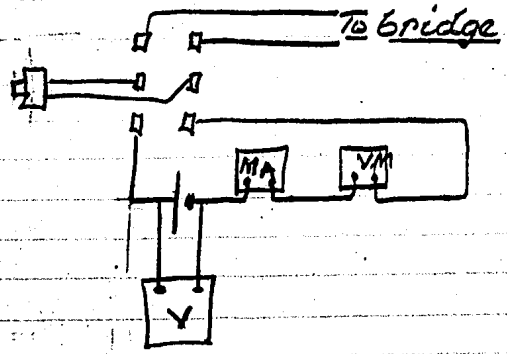
To check tried-



Voltmeter showed 1.37 on 1.5 scale
Millammeter " .0185

1.37 x .01337 = .0184169.

Measurement of Resistance of E-1 without and with current.



(1)

Bridge = 1580 ohms

V.M = .2 × .002857 = .0005714 amp.

V = 1.4 volts

R = 1.4 ÷ .0005714 = 2450 ohms.

(2)

Bridge = 4800 ohms

V.M. = .03 × .002857 = .00008571 amp.

V = 1.4

R = 1.4 ÷ .00008571 = 16,334 ohms.

(3)

Resistance of M-1 Microphone.

① resistance with bridge 12+ ohms. ± 13.

Current 4 milliamp.
1.32 V.M. Reading

Volts 1.4.

Test of M-1 Microphone.

Mr. E had Moore bring up his microphone for test.

With 1 cell - with audion as before, door open, could hear to 60.
With 1 cell - door closed, to 60.

Then put on musical record (for test). Quality very poor, jumbled and could only hear lower register but to 60.

Adjusted and put on more riders. Improved quality but could not hear so far to 50. Still muffled & only low.

Adjusted further. Improved quality ~~with~~ at expense of quantity so as to hear only to 44

Then used 2 cells. Hear at 50
Fair quality
Then used 3 cells. 44
Quality poor

Used 7 cells & readjusted 54.
Quality better.

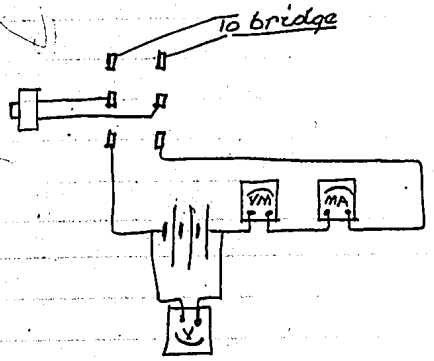
On test next morning
heard with 7 cells
musical record at 54

Same with W.E. talking
record 24
(Not as much noise with M-1)

Test of E-4 mounted in
6"x6"x6" lead block - enclosed
to 15°.

2 cells battery, door open talking record 60
" " " " closed " " 48
" " " " " music " 56
3 " " " " " " 60
more noisy than M-1 unit.
Noise seems to be that carried
by the air around.

Measurement of Resistance of E-4 in lead block.



①

Bridge showed 3700
V.M. = .09 x .002857 = .00025686 amp.
M.A = 1.1
V = 1.4 ÷ .00025686 = 5446
5446 - 350 = 5090 ohms
Jumped 1390 ohms with current

②

Bridge showed 5000
V.M. = .07 x .002857 = .00019999
V = 1.4 ÷ .0002 = 7000.
7000 - 350 = 6650
Jumped 1650 ohms with current
ours.

(3)

Bridge = 4000
VM = .08 x .002857 = .00023
V = 1.4 ÷ .00023 = 6087
6087 - 350 = 5737
Jumped 1737 ohms with current

(4)

Bridge = 2260
VM = .14 x .002857 = .0039998
V = 1.4 ÷ .004 = 3500
3500 - 350 = 3150
Jumped 890 ohms

Test of M-1 Microphone.

44

2 cells battery, musical record
door closed head to
Typewriter in next office
making so much fuss I can
not tell quality,
Listening at 7-V, quality not
very good. Uneven. Augments
some notes & diminishes others.

Suggest ~~that~~ the steel carrying
carbon contacts on M-1 be eliminated
and these contacts be carried direct
on diaphragm to save weight.

Test of M-R Microphone.

2 cells battery, music record door open 42
2 " " " " door closed 28
Not loud enough over room noises to judge quality.

Rubber stopper in goose neck
2 cells battery, music record door open 26
" " " " " door closed 14
Makes best quality of what I get is better, cleaner & sharper & clearer.

Mr. E. then took off ear bar (span of fingers and adjusted these so as to have more weight
1 cell battery - music record - door open 46
1 " " " " " closed 26

Test of Tuned Reeds.

Tried to tune up new vibrator to old, heavy spring, wooden base one. Found it necessary to push weight back as far as possible or remove to make old one fast enough to synchronize with the new.

When tuned, the new one would quickly respond from 6' away.

Found that when its magnets were placed close in, the swing was damped. This may be a direct damping action due to the generation of induced current but I believe the natural period of vibration of the reed is changed by the change of amount of controlling force due to the addition of the force of the magnets.

Then tuned up the small reed on cast iron base to heavy reed. Both now respond each time.

(3) A = vibrating
B = responds because tuned
D = running
E = closed.
Within 4 seconds after A is started can hear B very plainly.

(4) Repeat 3 but using both magnets on ⊖ connecting blue to blue. Can hear plainly. Sharp & clear.

(5) Repeat 4 but connecting blue to purple terminal. Can hear but not as plainly as before. Apparently blue & blue connects magnets in proper direction.

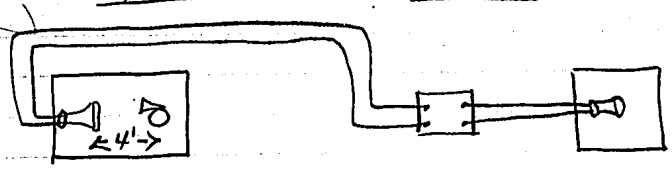
(6) Connected magnets in parallel blue to blue & purple to purple. Can hear but not as well as before.

(7) Connected magnets in parallel, blew one to pieces & other. Better than (6). This is the right way for parallel connection. Series connection seems to give little better effect than parallel.

(8) Removed the old master vibrator to floor near booth and connected electrically to magnet of new vibrator after having first put similar magnets on master vibrator.
The second vibrator did not respond.

(9) Tried experiments in response in various parts of my room. Found second bell would respond from any part of bench but not from any other part of room, proving that the motion was conveyed through shaking of bench.

Test of Magnetic Transmitter E-6



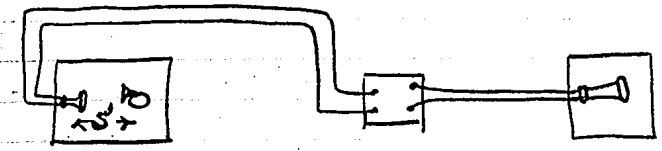
Magnetic receivers 4' from phonograph in box.

Audion with Bunnell 11-2800 input and 520-100 output coils.

E-6 heard to 20
(Quality poor - fuel, slow)

Bell Telephone heard to 4·8

Test of special receiver against standard.



① Connected up coils of receiver in series ~~to get~~ maximum effect.

This showed two interesting phenomena.

The sound is different from ordinary receiver on making contact with battery, in place of the sharp click there is a double sound as if it took the diaphragm an appreciable time to travel to its limit.

When current traverses magnets so as to assist them the sound is less loud than when it traverses the opposite direction. This is probably due to the

small section near the receiver. The permanent magnet is so much larger than this section that it is normally saturated. An increase in magnetic strength due to the coils sends but few additional lines through. A decrease in strength due to opposed coils however changes the number of lines greatly.

① Bell telephone as transmitter, 5' from phonograph in box connected directly to receiver

Could hear with Bell Receiver plainly. Could not hear with special receiver.

② Then took phonograph out of box and brought

transmitting receiver up until could hear with special receiver. Transmitter 1 ft. from Room.

Hear Special Receiver connection to	18
" Bell " "	60
Special receiver connected in parallel to	10

Then tried to see if could hear low frequency through special receiver.

Connected large vibrator with magnet.
Could not hear at low or high frequency direct

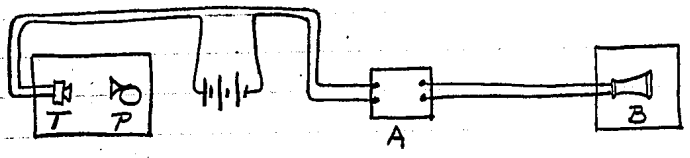
Then connected buzzer in series

Can not hear with vibrator otic or going.

Then connected in audion using special receiver.
Cats not hear

Then put on Bell receiver.
Cats hear very plainly

Test of Transmitter E-31.



① Set up usual way with 1 cell battery, phonograph in box, door open.
Could hear nothing.

② Then had Dawson shout in T.
Could just hear.

③ Then put bell telephone in place of T.
Could hear loud & clear.

④ Measured resistance of T.
Found 37,500 ohms by bridge
30,460 " " ammeter & voltmeter.

⑤ Then had Mulner take out all but 3 discs to diminish resistance.
Giaum open circuit due to broken

tin foil strip on diaphragm.

⑥ Then had strip renewed
Resistance with 3 discs 2,200 ohms
by bridge 1,531 ohms by ammeter,
voltmeter method.

⑦ Then connected up in usual
method with 2 cells of
battery. Door open
Could not hear at all

⑧ Then had Dawson talk directly
in opening of T.
At first, blasted & broke — then
settled down and talked very loud
and very clear.

⑨ Then tried ⑦ over, with door
open.
Could not hear.

⑩ Then put rubber stopper
in opening of T. Door open
Could not hear.

(11) Mr. E had Meilner cut down the weight on the arm of T so as to give less pressure and to replace total number of 10 discs.
Could not hear.

(12) Had Dawson talk direct in tube of T.
Could hear faintly but the transmission showed breaks - was choppy & broken.

(13) Mr. E had Meilner put carbon contact on weight so that contact moved be carbon to carbon and not carbon to brass.
Could not hear.

(14) Had Dawson talk direct into T.
Could hear faintly. Sometimes with blasts. At times even reliable but very faint.

(15) Found resistance as set up to be above 100,000 ohms.

Mr. E proved by putting weights on the carbon discs, that these must be separated by a molecular air space. Hence the enormous resistance.

(16) Mr. E then had Mr. Ineson roughen the discs. Using 4 of them with 2 cells of battery.

With door open	60
" " closed	40

(External noises especially loud this morning because of high wind rattling sash of building and several people talking outside booth)

(17) Mr. Edison then wanted us to test quality by reading from news paper &c.
With resistance in coil hear about 40%

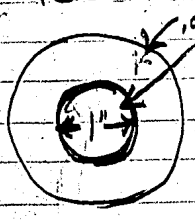
(18) Put Bell Telephone in place of transmitter
Door open to 4
Closed to 0

Shows ~~that~~ so called dynamo noise was probably dynamo noise

(19) Mr. E had .003" steel diaphragm put in Bell receiver as transmitter. Electricity for heating was cut off here so "dynamo sound" stopped Heard this to 14.

(20) ~~Mr. E had Meitner make diaphragm for Bell transmitter of Mica .002" with .003" steel disc 1" diameter in center. Heard to Dynamo noise gone. This I do not understand.~~ 10

(20) Mr. E had Meitner make special diaphragm for Bell Receiver used as transmitter



Door Open.

Paper ring in - not clamped
Near to
(no dynamo sound) 12

(21) Paper ring out, not clamped but diaphragm close to magnets 22
No dynamo sound

(22) Clamped, steel opposite side of diaphragm from mica 28
(No dynamo sound) Best yet

(23) Same as above, door closed 10

(24) Reversed diaphragm, steel next to magnet. Door closed Can't hear. Diaphragm touches magnet.

Test of 2 stage audion against 3 stage.

Used phonograph in box. Regular Bell Receiver in Mallory's room in regular transmitter position as transmitter. Door open

With 3 stage audion 52
" 2 " " 12

Door closed

3 Stage audion Regular Bell T. 36
" " " Mr. E " T —

Connected up output of 3 stage audion to input of 2 stage audion.

With Bell Receiver on transmitter table, with door closed Reads to 60

Box at 0 Loud
Noise 100% (95%) Sound 100% (5%)
Noise consists of a continuous roar and very high pitched whistle interspersed with periodic breaks & pops

Box at 30
Noise 10% (50%) Sound 100% (50%)

Box at 60 (1/2%) (1%) Sound 2% (99%)

Test of 5 stage amplifier using Burnell 11-2800 input and 520-100 output coils.

Circuit very noisy, apparently worse than last night when the N.E. input and output coils were used on 3 stage.
Noise does not diminish at 30 as before
Hear phonograph to 98

Found that in making these connections, we did include the resistances in shunt with the input circuit.
Connected up putting Bunnell coils in place of N.E. input and output.
Result very poor. Lots of noise. Sound low.
Then cut off 2 stage audion, using 3 stage only.
Both noise and sound weak. Could only just hear Dawson talking direct in Beck Laboratory as transmitter.

Test of 3 stage amplifier.

To insure against mistakes, connected up 3 stage amplifier again.

With door open, could not distinguish phonograph.

Changed Bell receivers. Got phonograph to 50

Noise Pronounced. With 1st Bell receiver used the dynamo noise was especially prominent.

With the second one used, the dynamo noise largely disappears and a high pitched non periodic roar appears.

It may be that the second is better than the first because the periodic phonograph sound is more pronounced with the non periodic roar than with the periodic dynamo sound.

This was taken with Rhs 9900

1st switch Low
2nd Switch high

Changed 1st switch to high.
Got periodic pump noise
showing condenser discharge

Noise increased with this but
was not able to hear phonograph
at any point.

Changed 1st switch to Low
2nd " to Low
Noise very much diminished
Hear phonograph 16

Leaving 1st switch at Low
2nd " at high
put Rheo at 5000
to Hear to 40
Rheostat on 1000 (some better)
Hear to 46
Rheostat on 500
Noise reduced Hear to 36
Rheostat on 100
Noise reduced Hear to 16

① Rheostat at 100
1st ~~switch~~ switch high
2nd " "
Hear it 66

② Same Rheostat at 300
High pitched noise. Pump
annoying
Can hear only to 8

③ Rheostat at 100
Again get phonograph to 54
(Pump sound annoying)

④ Rheostat at 50 34

⑤ Then connected up with 2
stage audion
Rheostat at 100
1st Switch high
2nd switch high
Sings high pitched note -

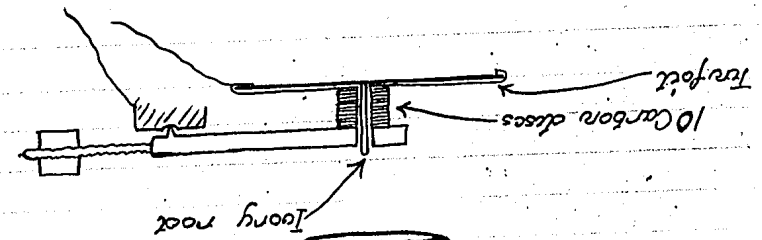
⑥ Then tried varied rheostat
positions & changes of switches
Got only a variety of noises

(7) During this trial grounding several positions among them #4 of 1st - 2 stage audion. Noise stopped and stayed quiet.
Heard phonograph with door closed to 60
Noise awful at low reading but rapidly cuts out.

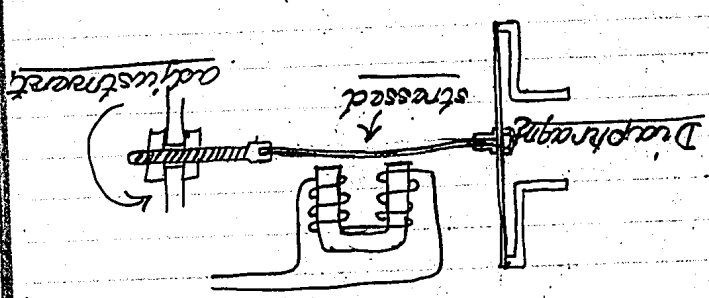
(8) Then opened rheostat circuit by switch. Could still hear at 60

(9) Then threw first switch to high, leaving rheostat open.
Noises on line very much reduced - only high pitched whistle and a periodic grunt. Can hear to 60

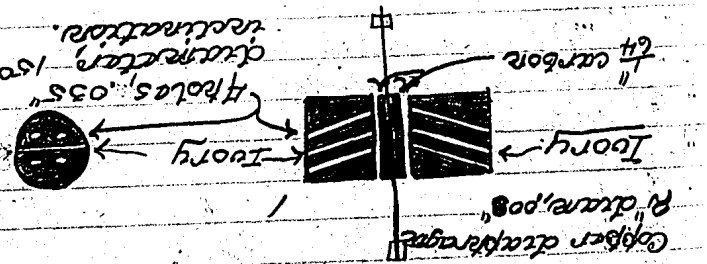
(10) Closed switch to Rheostat which was at 9000
Same as (9) in results
Hear to 60



H-31



H-6



H-5

(11) Changed Rheostat to 900 Near th 60

(12) Then changed switch #1 to low, Rheostat 9000 noises increased but sound near phonograph distinctly at 60

(13) Permanently attaching ground to H of first adjust H two stage Audio High Peak note x diminishes Sensaluness th 46

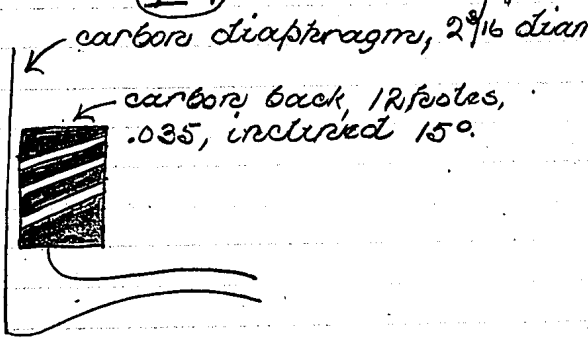
(14) Removing this ground brings back as at 12 th 60

(15) A 1 mfd condenser around the resistance Rheostat diminishes the noise but does not diminish the phonograph, Near loud at 60.

[THIS BOOK WAS USED IN BOTH DIRECTIONS. THE FOLLOWING PAGES WERE FILMED FROM THE BACK END FORWARD.]

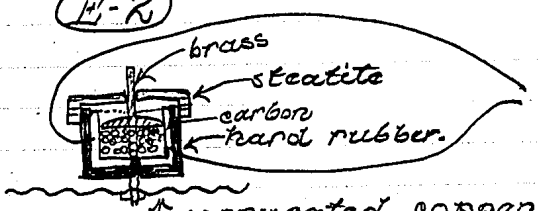
Description of Transmitters.

E-1



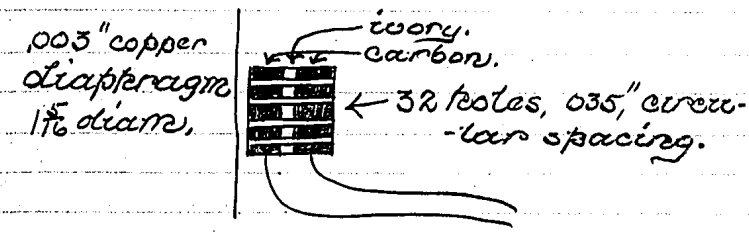
E-2

Inertia Type,

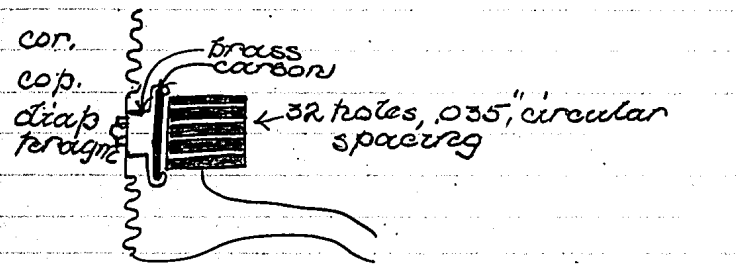


corrugated copper diaphragm, 1 5/16" diameter.

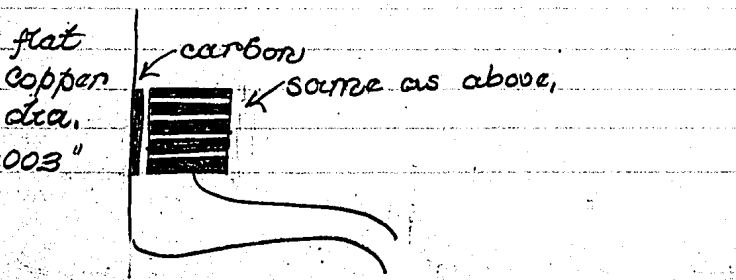
E-3



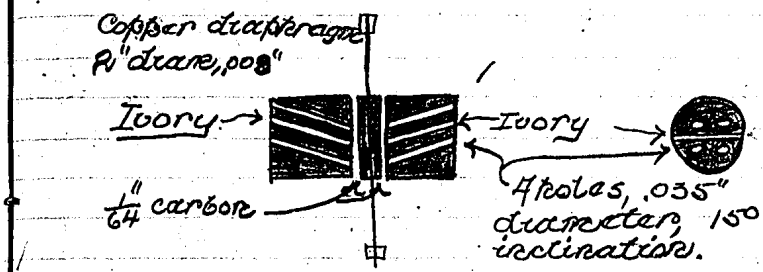
E-4 - 1st form



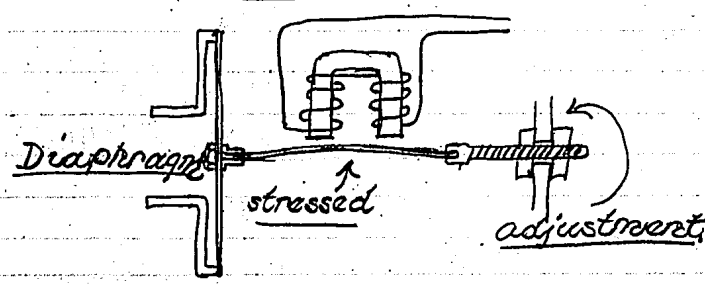
E-4 - 2nd form.



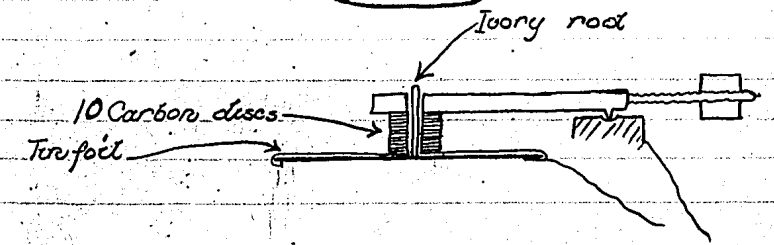
E-5


Copper diaphragm
R"diam, .008"
Ivory
Ivory
Ivory
1/64 carbon
4 holes, .035" diameter, 150 inclination.

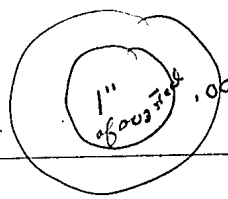
E-6


Diaphragm
stressed
adjustment

E-31


Ivory rod
10 Carbon discs
Tin foil

[ITEM(S) FOUND IN BOOK]

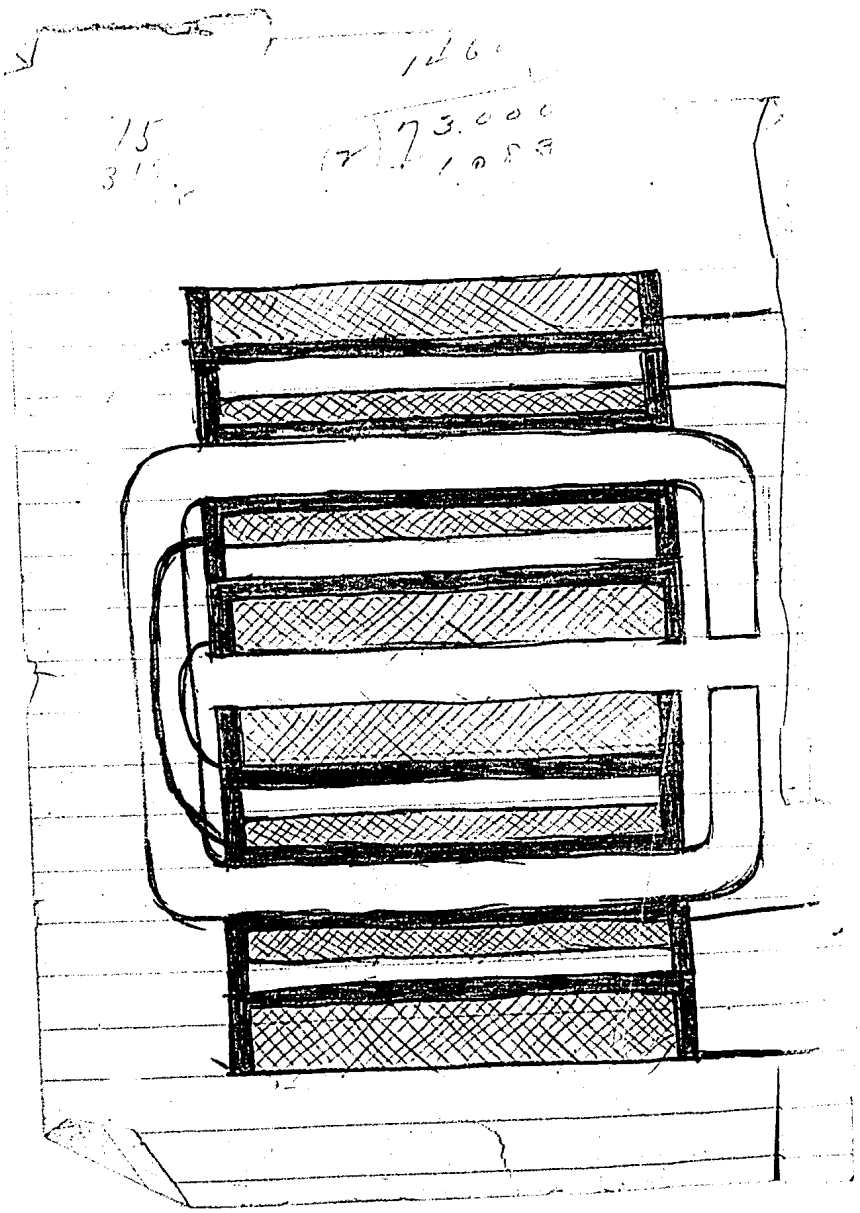


Paper ring in - not clamped
#12 on box - 003 steel 1" dia
no dynamo sounds

Paper ring out not clamped
but close #22, on box -
no dynamo sounds -

Clamped get #28 on box
Reed yet no dynamo
sounds Steel opposite side
to magnet - on mica -

Door shut. # 10 on box

Reversed dia. steel next magnet
door closed, not clamped tight
Can't hear - dia touching magnet

[ITEM(S) FOUND IN BOOK]